TECHNICAL SUPPORT DOCUMENT
BLM-Pinedale Field Office
Specific Guidance for the Application of the Regional Framework for Water-Resources Monitoring Related to Energy Exploration and Development in the Upper Green River Basin, Wyoming

On November 30, 2012, the High Desert District (HDD) Management Team agreed to implement the Regional Framework for Water-Resource Monitoring Related to Energy Exploration and Development (Regional Framework), U.S. Geological Survey, Colorado Water Science Center, September 30, 2007, process for the Normally Pressured Lance Natural Gas Development (NPL) and La Barge Platform Exploration and Development (La Barge Platform) projects in the Upper Green River Basin (UGRB).

The Regional Framework was prepared with the overall goal of developing "a practical approach to integrated water-resources monitoring related to energy development that capitalizes on existing monitoring programs and readily available data and information" (Regional Framework, p. 4). The Regional Framework was followed in the Pinedale Anticline Supplemental Environmental Impact Statement (EIS) Record of Decision (ROD, Sec. 4.2, p. 29, 2008) and is appropriate for use in the NPL and La Barge EIS projects and future, comparable oil and gas development projects in the UGRB. Consistent management between oil and gas development projects in the UGRB supports the Pinedale Resource Management Plan Objectives (RMP, Sec. 2.3.13, p. 2-41, 2008).

The Regional Framework provides a science-based process for the development of surface water and groundwater Monitoring and Mitigation Plans (MMP) for larger oil and gas projects. Specific portions of the Regional Framework share a close relationship with the NEPA process and associated analysis. The BLM developed this Technical Support Document for the Regional Framework in response to NPL and La Barge Platform project proponents' requests for specific guidance regarding interpretation of the Regional Framework, to guide the NEPA EIS and ROD processes, and the eventual development of MMPs for surface water and groundwater resources within the UGRB.

The Technical Support Document is divided into three sections followed by a comprehensive checklist of data considerations and action items:

Section I: A brief summary of the Regional Framework's seven-step process;
Section II: Recommended checklist for NEPA analysis and considerations for ROD requirements; and,
Section III: Recommended actions to implement Regional Framework Steps 1-7 for monitoring plan design and implementation.

The NEPA process, as it relates to the complexity, nature, and scope of hydrologic issues associated with a proposed project, will determine the design, level of detail, and intensity of water-resource assessment and monitoring outlined in the Technical Support Document. Project proponents may be required to provide rationale for any variances in implementation of the guidance in the Technical Support Document as it pertains to the NEPA process and/or preparation of a MMP. The BLM will determine the appropriateness of any proposed variances on federally-managed lands and resources, and may consult with other partner agencies in making these decisions.

SECTION I
SUMMARY OF REGIONAL FRAMEWORK STEPS 1-7

Step 1: Specify monitoring goals and objectives

Specify clear goals and objectives which need to be met. Monitoring goals and objectives are generally driven by regulatory standards which provide the minimum criteria that must be met.

Step 2: Characterize anthropogenic [man-made] stressors that may affect receptors and parameters of interest.

Develop a list of all potential stressors to water resources from the proposed project. Stressors can be determined from the analyses in the Resource Management Plan (RMP) and EIS, or identified in EIS preparation. All identified potential Impacts should be recorded and distilled down to hydrologic concern statements that identify the potential source, pathway, parameter, and receptor related to each concern (See Regional Framework, Step 2, for examples of concern statements).

Step 3: Develop regional questions and conceptual models to describe the process and pathways, [and] anthropogenic stressors [that] may affect receptors.

Strive to understand how stressors and receptors are linked and what effect stressors have on receptors. This is the core component of setting up a regional monitoring strategy as it provides for an evaluation of the validity of concerns.

Develop a conceptual model to qualitatively describe the function of a hydrologic system, to anticipate effects of anthropogenic stressors, and to inform the development of a regional monitoring plan. It can also aid in determining data gaps which need to be filled during monitoring activities. Conceptual models are initially based on existing data, but should be refined as new information becomes available throughout the life of the project.

Step 4: Suggest indicators to measure the effects of anthropogenic stressors and define existing information availability and needs.

Identify indicators, or parameters that can be measured and represent the condition of a receptor in the hydrologic system. The best indicators are easily obtained, sensitive to the effects of the anticipated anthropogenic stressors, and are closely linked to the receptor of *concern. They can be regulatory, such as water-quality standards; or proxies that reflect the status of an important water-resource parameter, such as water level or stream flow. They can measure regional or local and long-term or short-term impacts.*

Step 5: Estimate the sensitivity of the indicators to detect change, to guide final indicator choice and monitoring design, how the parameters or indicators detect change.

Understand the response of an indicator to (a) stressor(s), the sensitivity of an indicator to change, and how it is affected by natural variability in the hydrologic system to guide the final choice and monitoring plan design. The sensitivity of an indicator to detect change will help to determine the spatial and temporal frequency of monitoring.

Step 6: Describe a process by which management can identify thresholds of change requiring a management response.

Set thresholds for action at levels sufficiently conservative so that, once required, timely management response will allow for mitigation and remediation of effects. Where no regulatory standard exists, thresholds of change could be identified by trends and occurrences of parameters outside natural variability and baseline which have the potential to cause unacceptable impacts.

Step 7: Identify clear connections between the overall monitoring program and the management decision process.

Define what management actions need to be taken if a threshold is exceeded or undesirable trend is detected. This step should describe a process rather than a definite response. If it is determined that thresholds have been exceeded and/or undesirable trends detected and the responsible stressors have been identified, this would provide guidance to managers for evaluating oil and gas activity to date and the effectiveness of existing best management practices (BMPs) and lease stipulations. This would allow managers to make adjustments to plans for future energy development.

SECTION II
RECOMMENDED WORK ITEMS FOR NEPA ANALYSIS AND CONSIDERATIONS FOR ROD REQUIREMENTS

The overarching goal of the Technical Support Document is to gain a sufficient understanding of both the surface water and groundwater resources to allow for resource protection in concert with efficient and effective monitoring. The items in the Technical Support Document represent a comprehensive list of recommended information, data, and/or analyses pertinent to the Affected Environment section of the NEPA document and would guide subsequent planning and management actions.

To communicate findings, summary reports should be prepared to document the available data, their interpretation, and use (e.g., characterizing resource conditions, model development, etc.) The rationale involved in these tasks, pertinent metadata, and recommended decisions based on these data and results should also be included.

These tasks and deliverables would be implemented for an area defined, with BLM concurrence, as an area of interest that should at a minimum include the full extent of subwatersheds that intercept the proposed project (e.g., 10 and/or 12 digit hydrologic units) as identified by the project proponent and/or within the boundaries required for identified models or studies.

In nature, surface water and groundwater are interrelated. For purposes of the Technical Support Document, work items and deliverables for surface water and groundwater are discussed separately for ease of understanding and implementation. Section II of the Technical Support Document is intended as a relatively comprehensive checklist of NEPA and ROD related surface water and groundwater resources data considerations and action items. The items listed in the Technical Support Document are not mandatory, all inclusive, nor specific to the NEPA formatted approach. Project proponents should consider these items (including their adaptation or augmentation), as the NEPA effort is planned and implemented. Links to potential data sources to aid in this effort are listed in the References and Websites section.

Data and information acquisition to aid in defining the area of interest and preparation for NEPA analysis and monitoring plan development should include all available information. Potential subjects could include, but not be limited to, the following:

Surface Water

1. Describe in both spatial and tabular formats, what is known about surface water in the area of interest.
    a. Identify all major streams, tributaries, wetlands, and springs within the area of study using the standard 24K National Hydrological Database (NHD) at the University of Wyoming (UW), Wyoming Geographic Information Science Center (UW/WYGISC), U.S. Geological Survey (USGS), National Resource Conservation Service (NRCS) or National Wetlands Inventory (NWI) websites.
    b. Delineate watersheds to identify potentially affected subwatersheds using the Watershed Boundary Dataset (WBD) available at the UW/WYGISC, USGS, or NRCS websites.
2. Inventory and verify all existing surface-water structures.
    a. Depict surface diversions, irrigation ditches, head-gates, water rights, flows, past and current gaging stations, and priorities using the Wyoming State Engineer's Office (WSEO), Wyoming State Water Development Commission (WWDC), UW Water Resource Data System (WRDS), and USGS website databases and reports.

3. Review pertinent existing published data and studies which describe surface-water characteristics. Items to be considered, could include:
   a. Types of stream systems including channel conditions, types of flow (i.e., perennial, ephemeral, intermittent), hydrographs (e.g. average, peak and base flows), occurrences of wetlands and springs, and riparian areas.
   b. Designated surface-water classes and documented uses, including recent consumption analysis.
   c. Stream health surveys including aquatic life (i.e., WDEQ standards), any water-quality threats or impairments, and Source Water Protection Areas.
   d. Spatial and tabular water quality/chemical characteristics of surface water:
      i. Native chemical types of surface water in streams and water quality (e.g., anions/cations, total dissolved solids, total/dissolved metals, electro-conductivity (EC), etc.), and location of surface-water sampling sites.
      ii. Existing and former land uses and their potential to have impacted local groundwater. Particular attention should be given to documentation of existing water quality and or quantity impacts (detections and Maximum Contamination Level (MCL) exceedences) by undesirable chemicals, organics (including hydrocarbons), and inorganics.
   e. Precipitation data (average monthly and annual rainfall/snowfall) for a period of record. Suggested sources of data include but are not limited to: NRCS Precipitation Reports, NRCS Snow Survey Data, UW Water Resources Data System (WRDS), Parameter-Elevation Regressions on Independent Slope Model (PRISM), Daily Meteorological Data (DAYMET), BLM's Wyoming Air Resources Management (WARMS) data, and UW (UWYO) weather data.
4. Geomorphic and vegetation relationships. This could include watershed characteristics, available soils inventory data (NRCS and others) with associated engineering interpretations, ecological site descriptions, vegetation types, and erosion potential (e.g. are there aspects that would aid or hinder reclamation efforts such as soil types and or headcuts that are draining watertables)
5. In consultation with BLM, create and run a watershed assessment model, such as Environmental Protection Agency, Region 8 (EPA)'s Automated Geospatial Watershed Assessment (AGWA) model, to simulate baseline/current conditions. Spatial and tabular data outputs, and their interpretation and discussion, should include:
   a. Set pertinent ranges and standard units of measure in the runoff and sediment model tabular data/reports outputs and related map legends, such as sediment yield and surface runoff (from upland planes), and channel discharge (by channel reaches), per unit time.
      i. To the extent possible, parameterize the models with the most robust and recent data available locally or regionally and calibrate the models with stream-flow and other pertinent data;
      ii. Produce color-coded maps for both the streams and upland areas depicting the degree of sedimentation and surface runoff to facilitate comparisons on a

subwatershed basis and with other data layers used in related resource impact analyses

iii. Prepare a spreadsheet summarizing the tabular sedimentation, runoff, and salinity data (for planes and channels); and,

iv. Evaluate/describe (the effects of current surface disturbance conditions and where they have the most significant impacts on the landscape on a subwatershed basis. This evaluation and description should be in terms of trend and magnitude of changes in surface runoff and erosion on a subwatershed or reach basis. Qualitatively interpret the above analysis results and relating these to salt mobilization and delivery.

6. As described in 5a., part i. through iv., above, adjust calibrated baseline models to reflect the pattern and extent of surface disturbance for each of the alternatives. Address the success of surface reclamation (spatially and temporally) as it relates to the surface disturbance and associated runoff, sedimentation, and salinity mobilization per unit time. Spatial and tabular data outputs, and their interpretation and discussion, should include for each alternative:
   a. Models with projected disturbance intensity and distribution for appropriate event intervals and intensities over the entire life of the project.
   b. Provide maps and spreadsheets as described in 5.a.ii, iii above.
   c. Evaluations/descriptions of where the impacts of forecasted or planned land-use change and surface disturbances are likely to be most significant.
   d. Comparisons and contrasts of the spatial and temporal impacts (sedimentation, runoff, and salinity mobilization, etc.), among the alternatives.
   e. Descriptions of mitigation measures and BMPs appropriate to the level of impacts and appropriately defined vulnerability classifications of individual subwatersheds:
      i. E.g., Highly Vulnerable Subwatersheds: monitoring to include flumes and water-quality analysis at selected live water locations, channel x-sections, measuring sediment in detention ponds, erosion pin plots, other, etc.; mitigation to include a selection of detention ponds, erosion control fencing, drop structures, hydro-mulching and mat pads at drill pads, using the AGWA Application for Permit to Drill (APD) toolkit or a comparable method to aid in locating pads and roads in most stable areas, or other measures; and,
      ii. E.g., Minimally Vulnerable Subwatersheds: monitoring may include photo plots of channels and cross-sections at major channel confluences, vegetation identification, and other low intensity measures; and mitigation to include mat pads, erosion fencing, etc.
7. Summarize pertinent changes in water resources, their related values, and infrastructure (e.g., water handling, disturbance mitigation, channel geomorphology changes, etc.) for each alternative. That is, for affected elements in Items 2 through 5 above, describe, in spreadsheets and maps as appropriate, any projected changes in surface water resources and their conditions.

Groundwater

1. Compile and review all available information regarding groundwater in the area of interest.
    a. Review pertinent existing published data and studies including but not limited to:
        i. Groundwater studies, models, characterizations in the vicinity of the area (e.g. Wyoming Geological Survey, Green River Basin Water Plan II, Level II, 2007-2009, Clarey, et al, 2010).
    b. Describe the geology and geologic structures in the area of interest.
    c. Describe geologic formations of interest (especially water-bearing units), including thicknesses, lateral extents, rock types, production, and depths.
2. Inventory all existing water wells and springs and provide these data in spreadsheets and maps.
    a. Consider data including, but not limited to, total depths, static water levels, well yields, WYSEO permit number, type of permit, water rights, consumptive use (amount and type), location, perforated intervals, casing information, construction and completion data including but not limited to: source aquifer(s), and pumping data; or any other pertinent data (WSEO and WOGCC databases).
    b. Identify which water wells may be suitable/credible for water-quality monitoring.
3. Describe and/or determine hydrogeologic characteristics, such as permeability, transmissivity, and hydraulic conductivity, of the following in the area of interest including, but not limited to:
    a. Aquifers and confining layers using existing well logs, seismic data or other subsurface techniques.
    b. Recharge areas.
    c. Groundwater vulnerability areas.
4. Use existing, or create as appropriate, potentiometric maps from static-water levels for various aquifers in GIS spatial formats; include locations and their identification numbers for those wells used in this exercise.
5. Determine potential hydraulic connection between surface water and groundwater.
6. Compile and describe water-quality characteristics of groundwater:
    a. Identify and summarize, using standard chart techniques, the native chemical types of groundwater in aquifers potentially impacted (e.g., Stiff and Piper Diagrams).
    b. Spatially document, list, and summarize water well sampling sites.
    c. Provide spatial and tabular documentation of existing contamination (detections and MCL exceedences) by undesirable chemicals, organics (including hydrocarbons), and inorganics.
7. Develop a comprehensive or relational geodatabase of all areas of groundwater concerns including but not limited to features, showing locations, and all known attributes, including groundwater recharge areas, Sole Source Aquifer Protection areas, water wells, springs, and known areas of vulnerability, such as Source Water Protection areas.
8. Summarize pertinent, projected changes in hydrogeologic resources, their related values, and infrastructure (e.g., water wells and their locations, projected drawdowns, alterations to recharge and discharge areas, changes in water levels and chemistry, etc.) for each

alternative. For impacted elements in Items 2 through 4 above, describe, in spreadsheets and maps as appropriate, any projected changes in groundwater resources and their conditions.

Other datasets, reports, and information discovered in the process of this acquisition may be considered for incorporation into the NEPA analysis and in monitoring plan development on a case-by-case basis. Surface water and groundwater actions pertaining to the development of a water-resources MMP should be consistent with the processes as outlined in the Regional Framework. The ROD should include, but not be limited to, the following deliverables, considerations, and points of decision:

1. As-built shapefiles documenting actual surface disturbance and reclamation on an annual basis.
2. Re-run appropriate model simulations if necessary.
3. Shapefiles with attribute tables (e.g., geodatabase) documenting the annual status of vegetative recovery until fully recovered with desired plant community;
4. Necessary research, documentation, and reporting of all available surface and groundwater data , such as water levels, quality, flows, pumpage, etc., and their consideration and incorporation into:
   a. Surface water and/or groundwater data-gaps report describing what additional inventories or studies are necessary.
   b. Water balance analysis.
   c. Surface water and groundwater characterization studies and reports.
   d. Conceptual surface water and groundwater models based on all data and other studies and models.
   e. Mathematical models (analytical or numerical), if conditions merit, depicting existing and/or predicted groundwater flow rate and direction, surface-water and groundwater interaction, drawdowns and water levels, etc.
   f. Updates of previously prepared surface water and groundwater models as required in consultation with BLM based on monitoring results for surface and groundwater resources. These updates may be necessary on a cyclical basis to verify monitoring results and aid decision makers in defining action levels and appropriate management actions to protect water resources.
      i. Additional modeling updates (e.g. AGWA) for adaptive management applications pertaining to runoff, sedimentation, and salt loading to satisfy the Colorado River Salinity Control Program and salinity standards.
5. Surface water/groundwater depletions monitoring and an annual report documenting annual withdrawals, recycling and reuse information for all operations.
6. Well logs for all industrial water wells and the first oil and gas wells on each multiwell pad.
7. Watershed assessment modeling outputs (e.g., AGWA) derived from the NEPA process to:
   a. Acquire or prepare Shapefiles for the selected alternative depicting the minimally, moderately, and highly impacted subwatersheds.

   b. Propose specific surface water and soil erosion monitoring actions (type, frequency, intensity, etc.) and BMP mitigation for each of the impacted watersheds.
   c. Require the preparation of annual reports regarding the effectiveness of BMPs (quantitative data such as sediment accumulation in runoff/erosion retention ponds, erosion pin transect measurements, flow and water-quality data at gaging stations, etc.) and qualitative information such as photo logs.
8. Surface water and groundwater/aquifer pollution prevention, monitoring and mitigation plan consistent with the Regional Framework process and guidance in Section III.

SECTION III
RECOMMENDED ACTIONS TO IMPLEMENT REGIONAL FRAMEWORK STEPS 1-7 FOR SUBSEQUENT MONITORING PLAN DEVELOPMENT

Summary report(s) should be prepared to document the recommended data, its interpretation and use (e.g., in characterizing resource conditions, model development, etc.), the rationale involved in these tasks, pertinent metadata, and decisions based on these data and results. Summary reports should follow the general outline of the Regional Framework. The development of a MMP may precede the ROD or be required as an action item in the signed ROD.

Step 1: Specify monitoring goals and objectives

1. Describe what is known about the federal, state, and local regulations. Establish who has administrative and regulatory jurisdiction over surface water and groundwater resources. In Wyoming:
   a. The WSEO regulates and administers surface water and groundwater resources of the state of Wyoming, including:
      i. Permits for diversions, reservoirs, and in-stream flow, drought management, manages the cooperative state-wide stream gaging stations, and adjudicates surface-water rights;
      ii. Issues groundwater permits to drill water wells, adjudicates groundwater rights, and conducts groundwater assessments; and
      iii. Is party to seven interstate river compacts through the Colorado River Compact.
   b. WDEQ administers water quality in the state of Wyoming through its Water Quality Rules and Regulations and Rules of Practice and Procedure.
   c. EPA has jurisdiction over drinking water through the Safe Drinking Water Act (SDWA).
   d. Army Corps of Engineers (ACOE) administers the 404 permits and regulations.
   e. BLM prepares the EIS and administers the ROD.
2. Identify entity(ies) responsible for mitigation, implementation, and compliance.
3. Describe how the project meets or addresses regulations and standards.

Step 2: Characterize anthropogenic [man-made] stressors that may affect receptors and parameters of interest.

1. Identify hydrological impacts to surface water and groundwater resources from the project as determined from the RMP, EIS and NEPA analysis.
   a. Include information such as: spacing and distribution of well pads, roads, pipelines or pace of development, etc.
   b. Identify aspects of the project that could potentially impact the current situation and identify, to the extent possible, whether these would be localized or regional in nature. All pertinent studies, reports and datasets should be acquired and provided. Such data and information could include:
      i. LIDAR, satellite imagery, soils GIS layers, vegetation GIS layers, current vegetative condition, surface water and groundwater information, well logs, precipitation data, and other data as needed or requested for their proposed development; and,
      ii. Development scenarios for the project in the form of GIS layers documenting anticipated pad and road locations and any surface disturbance.
   c. Describe influences and disturbances that would be associated with the project, such as increased erosion from surface-disturbing activities, stream depletion, and aquifer contamination and depletion.
2. Assess the aspects of the project to determine whether they would result in potential impacts.
   a. Identify, to the extent possible, the potential sources, pathways, parameters, and receptors and develop statements of concern, from which to rate potential impacts.

Step 3: Develop regional questions and conceptual models to describe the process and pathways, [and] anthropogenic stressors [that] may affect receptors.

1. Develop initial conceptual models of surface-water and groundwater baseline/current conditions and incorporate any additional models and/or reports from other accepted sources to create a regional understanding of these water resources and identify areas where more information is needed.
   a. Design the conceptual models to include the appropriate area of interest (domain) in the event that a mathematical model (analytical or numerical) is needed.
2. Identify data gaps that need to be filled before going forward. The regulatory agency may choose to evaluate the project and direction of effort to ensure that sufficient data are being provided.
   a. Describe what decisions or issues are affected by identified data gaps and, with BLM concurrence, identify the process whereby these data gaps will be filled.
3. If sufficient data are not available, pursue activities that will obtain the needed data. The following conditions apply to all actions authorized in the project area under the ROD and may include:
   a. Drilling additional study wells at appropriate locations and depths to determine:
      i. Aquifer properties and hydrologic characteristics; and,

ii. Target zones for testing and water-quality sampling.

4. Develop and run surface impact analysis models (e.g., AGWA or others) to:
   a. Identify general levels and types of surface disturbance, potential changes in runoff, soil erosion, water quality and flow.
   b. Identify possible type, timing, and locations of BMPs for impacted watersheds and landscapes.
   c. Determine the nature and extent of potential impacts.
5. Determine potential sedimentation, salt loading, and runoff in quantitative terms and describe the significance of these levels.
6. Determine existing groundwater quality (i.e., organic, inorganic).
7. Obtain a list of potential chemical components that could be used or accessed under the project.
   a. Determine which chemical components or their reaction byproducts are of concern to health and the environment, and/or, are suitable tracer products.
8. Develop a mathematical model as appropriate (e.g., analytical or numerical model, such as MODFLOW), to:
   a. Simulate baseline/current conditions.
   b. Determine groundwater flow direction and rates.
   c. Predict potential contaminate fate and transport.
   d. Determine hydraulic connectivity to streams/springs and potential leakage to overlying or underlying formations/aquifers.
9. Revise conceptual models as necessary to incorporate additional information about the area of interest, including various surface-water and groundwater parameters, such as hydrologic attributes and relationships, constraints, and any aspects that would change the baseline or current conditions.

Step 4: Suggest indicators to measure the effects of the project and define availability of existing data and needs.

1. Interpret research, documentation, and reporting of all available surface-water and groundwater data from Step 3 to further refine what is known about baseline/current conditions.
2. Choose indicators that are specific to the area of interest and sensitive to change from baseline/current conditions. These indicators may be regulatory and/or measure unregulated but related factors. Often, indicators are defined in the conceptual model or mathematical models (analytical or numerical), as well as RMPs, EISs, and BLM land health standards; e.g.:
   a. For surface water, Class I-V stream standards of water quality, sediment yields, stream flow, specific water-quality contaminates, riparian vegetation, and fish or macroinvertebrates; and
   b. For groundwater, WDEQ/EPA water-quality standards for well water, groundwater levels, pumping rates, and drawdowns.
3. Determine the most effective/representative indicators for the project (see Step 3, above).

4. Determine the most effective and accurate methods of sampling and analysis to detect the constituents of concern, and reevaluate as future conditions warrant.
5. Design indicators to identify responsible stressor sources.

Step 5: Estimate how the parameters or indicators detect change, guide final choice and monitoring design.

1. Analyze and interpret results and data relative to baseline/current conditions.
2. Design a monitoring plan that:
   a. Identifies the response of an indicator to a stressor based on information gathered in Step 3; and,
   b. Determine the spatial distribution and frequency of indicators chosen based on the sensitivity of the indicator as characterized in the Conceptual Model, mathematical models (analytical or numerical), and information gathered in Step 3.
3. Articulate specific questions that need to be answered by monitoring (e.g., Is A causing X to be greater than Y at location Z?).
   a. Determine if there is sufficient historical information available to allow for a comparison of historical and contemporary data.
   b. Determine whether monitoring control sites need to be installed to further define baseline conditions.
4. Using information developed in Step 4 to:
   a. Determine the frequency and thoroughness of monitoring actions needed to detect significant change in a timely manner.
   b. Determine locations and methods to detect significant change in a timely manner.
5. If a need is indicated by the previous steps, develop and execute additional monitoring and/or modeling to detect and/or predict the impacts of stressors on indicators.

Step 6: Describe a process by which management can identify thresholds of change requiring a management response.

1. Identify responsive, representative, measurable, thresholds to identify significant levels of change from baseline conditions at various stages of development.
   a. Define action levels as necessary to avoid exceeding thresholds. (e.g., including but not limited to NRCS's allowable soil loss factors, WDEQ and EPA water-quality standards, and Colorado River salinity standards); consider also a spreadsheet tabulating and summarizing total allowable annual soil loss for each soil-map unit within the highly vulnerable and/or impacted subwatersheds for comparison to actual monitoring data and predictive modeling results).
      i. Additional modeling efforts may be required, (e.g., AGWA, Revised Universal Soil Loss Equation (RUSLE), Water Erosion Prediction Project (WEPP), and/or Rangeland Hydrology and Erosion Model (RHEM) etc.); selection of the model(s) and extent of use would be determined based upon existing data, questions being asked, and environmental vulnerabilities in the potentially

affected areas. Results of additional modeling efforts could be used in defining specific action levels (e.g., allowable soil loss and associated adaptive management actions).

   b. Identify specific sources or potential specific source(s) of contamination if action levels or thresholds are approached.
   c. Determine what actions will be taken when action levels and/or thresholds are reached (e.g., plan/stage implementation of more protective BMPs, reduce the amount of surface disturbance through well pad placement or pace of development, etc.).

b. As necessary, prepare and run model updates using monitoring data inputs and model calibration/validation with subsequent projection relative to action levels and thresholds.

Step 7: Identify clear connections between the overall monitoring program and the management decision process.

1. Propose surface-water and groundwater monitoring (including sedimentation and runoff) consistent with WDEQ's Sampling Analysis Plan format and QA/QC protocols and procedures.
2. Define adaptive management scenarios:
   a. Incorporate modeling update results to better define the adaptive actions.
3. Describe monitoring, mitigation, and BMPs for the project. Include details, such as type, location, frequency, and intensity of each.
4. Develop a predetermined plan of action based on monitoring results to avoid exceedences of state and federal water-quality standards, thresholds, and BLM identified action levels designed to protect resource values.
5. Prepare and submit monitoring and mitigation reports, in a BLM approved format, on at least an annual basis. These reports should include, but are not limited to:
   a. For surface water: analysis of the effectiveness of BMPs (quantitative data such as sediment accumulation in runoff/erosion retention ponds, erosion pin transect measurements, flow and water quality data at gaging stations, channel cross-sections, channel morphology (gradient, sinuosity, width/depth), Multiple Indicator Monitoring (MIM), etc.), and qualitative information such as photo logs.
   b. For groundwater: changes in water quality associated with constituents of concern, in water levels, well yields, hydrologic characteristics, groundwater gradients, and other indicators.
   c. For watershed conditions: changes in sedimentation, runoff, and reclamation success on a subwatershed basis (BLM Reclamation Handbook).
6. Refine and update previously prepared models as required in consultation with BLM based on monitoring results for surface and groundwater resources (i.e., Items 4 and 5a. b. and c.). These updates may be necessary on a cyclical basis to verify monitoring results and aid decision makers in defining action levels and appropriate management actions to protect water resources.

The items described in the Technical Support Document above for Regional Framework application are recommendations based on current knowledge and understanding of surface water and groundwater characteristics, issues, and management options/measures that are anticipated to protect these resources. These items are not all inclusive and will likely see further refinement as more is learned from on-going water resources impact monitoring, modeling, and assessment of BMP effectiveness. As a result, the execution of the Regional Framework guidance is still an iterative process based on scientific principles, as implemented by BLM, state and federal regulatory agencies, and industry partners.

REFERENCES AND WEBSITES

U.S. Geological Survey (USGS), Colorado Water Science Center (CWSC), September 30, 2007, Regional Framework for Water-Resource Monitoring Related to Energy Exploration and Development, 2007: http://www.blm.gov/style/medialib/blm/wy/field-offices/pinedale/papadocs/water.Par.82963.File.dat/RF-WaterResMonitoring.pdf

Clarey, Keith El, Bartos, Timothy, Copeland, David, Haliberg, Laura L., Clark, Melanie L., and Thompson, Melissa L., August 2010, Green River Basin Water Plan II, Groundwater Study, Level I (2007-2009), prepared under contract for the Wyoming Water Development Commission by the Wyoming State Geological Survey (WSGS), U.S. Geological Survey (USGS), and Water Resource Data System (WRDS), in cooperation with the Wyoming State Engineer's Office (WSEO) and the Wyoming Oil and Gas Conservation Commission (WOGCC): http://waterplan.state.wy.us/plan/green/2010/finalrept/gw_toc.html

U.S. Army Corps of Engineers: http://www.usace.army.mil/

Colorado River Salinity Control Program: http://www.usbr.gov/uc/progact/salinity/

Daily Meteorological Data: http://daymet.ornl.gov/

Environmental Protection Agency, Region 8 (EPA): http://www.epa.gov/aboutepa/region8.html

National Resource Conservation Service (NRCS) Precipitation Reports: http://www.wcc.nrcs.usda.gov/cgibin/precip.pl?state=wyoming

University of Wyoming Water Resources Data System (WRDS) NRCS Snowpack Survey: http://www-wwrc.uwyo.edu/wrds/nrcs/nrcs.html

University of Wyoming WRDS PRISM: http://www.wrds.uwyo.edu/sco/data/PRISM/PRISM.html

University of Wyoming (UWYO) Weather Data for Wyoming:
http://weather.uwyo.edu/wyoming/select.html

Wyoming Water Development Commissions (WWDC): http://wwdc.state.wy.us/

U.S. Geological Survey (USGS) Water Resources of the United States: http://water.usgs.gov/

Wyoming Oil and Gas Conservation Commission (WOGCC): http://wogcc.state.wy.us/

Wyoming State Engineer's Office (WSEO): https://sites.google.com/a/wyo.gov/seo/

U.S. Fish and Wildlife Service (FAS) National Wetlands Inventory (NWI):
http://www.fws.gov/wetlands/